

PATENT

#19 Appeal
Brief
PATENT Appeal
CE 3/29/01

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) Group Art Unit 2823

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) March 21, 2001
(Date)

Thomas F. Smegal, Jr., Reg. No. 20,732

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REFERENCES

Box AF
Assistant Commissioner for Patents
Washington, D.C. 20231

This is an Appeal of the final rejection set forth in an Office Action mailed November 21, 2000 in the above-captioned application.

The real party in interest in this appeal is the assignee of this application, Micron Technology, Inc.

Appellants are unaware of any related appeals or interferences.

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Appl. No. : 09/037,945
Filed : March 10, 1998

III. STATUS OF THE CLAIMS

The application was originally filed with Claims 1-10. Claims 11-17 were added during prosecution. Claims 5-7, 10, 13 and 15 have been canceled. Claims 1-4, 8, 9, 11, 12, 14, 16 and 17 are pending in the present application and have been finally rejected in the Office Action dated November 21, 2000. Claims 1-4, 8, 9, 11, 12, 14, 16 and 17 are the subject of this appeal.

IV. STATUS OF AMENDMENTS

A Request for Reconsideration and Response to Final Office Action was filed January 19, 2001. No changes to the claims were proposed. Therefore, Claims 1-4, 8, 9, 11, 12, 14, 16 and 17 appear as they were presented in a pre-examination Amendment filed April 17, 2000. The appealed claims (in that form) are attached hereto as Appendix A.

V. SUMMARY OF THE INVENTION

In the field of silicon integrated circuit fabrication, the current processing involves forming a sacrificial oxide growth and thereafter removing the oxide growth to eliminate parasitic silicon nitride inclusions. The present invention is directed to the discovery that the wet oxidation process -- by which the sacrificial oxide growth is conventionally carried out -- can be completely eliminated along with the additional process steps of thereafter further growing and removing a sacrificial oxide layer for the silicon surface, by utilizing a single step involving an oxidant substantially free of hydrogen. Such a process modification has been discovered to prevent the formation of silicon nitride inclusions for which the conventional process required formation and removal of an additional sacrificial oxide layer. By creating a field oxide substantially free of nitride inclusions, it is possible to complete subsequent processing without the need for the sacrificial oxide growth and removal heretofore employed in conventional silicon integrated circuit fabrication.

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Claims 1-4 recite a process for forming an integrated circuit which involves growing a silicon dioxide field isolation region on a semiconductor wafer without forming silicon nitride inclusions. The process is accomplished by employing a hydrogen-free oxidant at a pressure of less than 30 atm wherein the gate oxide is formed without having to employ the conventional prior art step of sacrificial oxidation.

Claims 11, 12, 14, 16 and 17 recite a process for forming electrically isolated integrated devices on a silicon substrate involving the preliminary step of masking followed by growing a field oxide without forming silicon nitride inclusions through the use of a hydrogen-free oxidant at specific partial pressures and temperatures.

Claims 8 and 9 are defined in terms of a field isolation region formed by a process which avoids the formation of silicon nitride inclusions through exposing the field isolation region to a hydrogen-free oxidizing ambient at corresponding recited pressures.

VI. ISSUES BEFORE THE BOARD

A. Whether Claims 1, 2, 4, 8, 9, 14, 16 and 17 are properly rejected under 35 U.S.C. §103(a) as being unpatentable over German Patent 266885 (the German '885 reference);

B. Whether Claim 3 is properly rejected under 35 U.S.C. §103(a) as being unpatentable over the German '885 reference in view of Marshall et al. article and Myoshi et al. article; and

C. Whether Claims 11 and 12 are properly rejected under 35 U.S.C. §103(a) as being unpatentable over the Marshall et al. article in view of the Sze article.

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VII. GROUPING OF CLAIMS

All of the claims should be grouped together.

VIII. APPELLANT'S ARGUMENT

The Examiner has now maintained the same rejections of the pending claims for almost three years, i.e., in Office Actions dated May 13, 1999; January 12, 2000; June 6, 2000; and November 21, 2000. The Examiner's objections and reasoning have been repeated *verbatim* in spite of Appellants' amendments to the claims contained in the October 13, 1999, Amendment; and Appellants' further claim modifications first contained in an Amendment After Final dated March 13, 2000, which were resubmitted in a Preliminary Amendment with the Continued Prosecution Application (CPA) mailed April 17, 2000.

The Examiner's primary reference through all the aforementioned communications has been a document identified as German patent DD 266,885 (the German '885 reference) used alone to reject Claims 1, 2, 4, 8, 9, 14, 16 and 17; or in combination with secondary references to reject Claim 3. Claims 11 and 12 stand rejected on secondary references. In each case the rejections are under 35 U.S.C. §103(a).

The Examiner and Appellants are in agreement that the German '885 patent, as understood from the three-paragraph translation (as apparently further embellished beyond the translation by the Examiner) appended to the two-page German language document, has as its subject matter a two-phased MOS transistor manufacturing process using dry oxygen in the second phase for "white ribbon" elimination. The reference contains no suggestion whatsoever that would lead one of ordinary skill in the art to modify the cursory skeletal disclosure in the German '885 reference to eliminate its first process step, i.e., to eliminate the long used wet oxidation. Yet the Examiner contends such elimination would be obvious to one of ordinary skill in this art.

While conceding that neither the German '885 reference or, for that matter, "any other reference contains a suggestion to eliminate the first oxidation stage" (Advisory Action mailed February 8, 2001), the Examiner contends that:

"However, it is not necessary that a reference explicitly suggest such a modification. Motivation for the modification has been provided in the office action mailed 11/21/2000. To reiterate, it is well established that

elimination of a step and it's function is obvious if the function of the element is not desired. In this case, the function is decreased oxidation time."

The Examiner asserts that such modification of the prior art would be obvious to one of ordinary skill in the art, without being able to point to any suggestion in the German '885 reference or in any secondary reference, that would lead one of ordinary skill in the art to make such modifications. The standard to be applied is not whether a prior art reference could be modified to arrive at Appellants' invention, but whether a prior art reference suggests the modification necessary to arrive at Appellants' invention. "The mere fact that the prior art could be so modified would not have made the modification obvious unless the prior art suggested the desirability of the modification." *In re Gordon*, 221 U.S.P.Q. 1125, 1127, Fed. Cir. 1984. As Appellants have continued to point out, the German '885 reference not only fails to give positive instructions to omit the wet oxidation step, but the skilled artisan, from a reading of the German patent and/or its translation, would have no logical reason -- other than the hindsight displayed by the Examiner -- to modify the German '885 reference by eliminating that first phase treatment of a two-phase treatment process.

The Examiner's rejection of Claim 3 looks to the further teaching of both Marshall et al. and Miyoshi et al. to provide what the German reference lacks, i.e., any disclosure of oxidation at pressures greater than 5 atm or at any specific temperature for the second stage employed therein. The Examiner lifts from Marshall et al. an isolated disclosure of oxidation of silicon at 140 atm at 800°C and asserts that it would be comparable to a lower pressure (1 atm) at a hotter temperature (1200°C). Why one of ordinary skill in the art would look to this summary observation contained in Marshall et al. to modify the disclosure of the German '885 reference, containing no temperature or pressure parameters whatsoever, is not consistent with an appropriate combination of prior art references.

Similarly, the Examiner refers to an isolated reference in Miyoshi et al. to atmospheric pressure of 6.4 atm, to somehow justify appending such disclosure to the partial skeleton of a teaching provided by the German '885 reference. The Examiner can point to no teaching in the prior art that would suggest such a selective combination with Miyoshi any more than the prior art suggests the selective combination with Marshall.

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Claims 11 and 12 differ from Claim 1 by specifying a partial pressure between 5 atm and 30 atm at a temperature greater than 900°C. Thus Claim 11 is more limited than Claim 4, which is dependent from Claim 3, which in turn is dependent from Claim 1. Yet the Examiner no longer relies upon the German '885 reference in his rejection of Claims 11 and 12, but now raises Marshall et al. to the level of a primary reference and combines it with Sze for another rejection under 35 U.S.C. §103(a). While the Examiner admits Marshall does not disclose oxidation pressures less than 30 atm, the Examiner states his personal opinion -- again resulting from the hindsight gained from reading Appellants' application -- that "The choice of particular pressure would have been a matter of routine optimization within the teachings of the reference." That not being enough, the foregoing personal observation of the Examiner is then combined with the Examiner's selective reading of Sze, that allegedly "discloses the suitability of dry oxidation at pressures less than 30 atm on page 122."

While the Examiner has selected excerpts from pages 121-123 of a document identified as Sze, the reference contains no discussion of actual devices to which such "suitability of dry oxidation at pressures less than 30 atm" is being applied. Thus there is no teaching in the Sze reference that would lead one of ordinary skill in the art to combine it with the Marshall reference for the purpose of accomplishing dry pressure local oxidation of silicon to which Marshall is directed. While there is no doubt that one can go to many isolated prior art documents on the general subject of "oxidation of silicon," as the Examiner has done, and pick and chose "conditions" which can be alleged to correspond to other conditions in the novel process recited by Appellants' claims, the Examiner fails to point to any prior art teaching that supports such a random combination of "conditions."

In summary, it is believed that the Examiner's combination of prior art references is untenable when applied to the claims under final rejection, particularly as amended several times since the Examiner first raised the identical rejections in an initial Patent Office communication relating to the parent application.

IX. CONCLUSIONS

In view of the foregoing arguments, Appellant respectfully submits that the Examiner's rejection of Claims 1-4, 8, 9, 11, 12, 14, 16 and 17 for the various reasons stated are all improper and should be withdrawn. The Examiner's rejection should be reversed.

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X. APPENDIX A

Attached hereto is a copy of the claims on appeal in the present case.

Respectfully submitted,

KNOBBE, MARTENS, OLSON & BEAR, LLP

Dated: 3/21/01

By: 

Thomas F. Smegal, Jr.

Registration No. 20,732

Attorney of Record

620 Newport Center Drive, Sixteenth Floor

Newport Beach, CA 92660

(415) 954-4114

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APPENDIX A



APPEALED CLAIMS

- 5 1. A process of forming an integrated circuit, comprising:
 growing a silicon dioxide field isolation region on a semiconductor wafer
 without forming silicon nitride inclusions in said filed isolation region exclusively
 by means of a hydrogen-free oxidant at a pressure less than about 30 atm; and
 forming a gate oxide without a prior sacrificial oxidation.
- 10 2. The process of Claim 1, wherein the oxidant consists essentially of oxygen.
3. The process of Claim 1, wherein forming the field isolation region
 comprises exposing the semiconductor substrate to the oxidant at an oxidant partial
 pressure greater than 5 atm.
4. The process of Claim 3, wherein forming the field isolation region
15 comprises maintaining the semiconductor substrate at a temperature greater than 900 °C.
8. A field isolation region among integrated circuit devices on a
 semiconductor substrate formed by a process comprising:
 avoiding the formation of silicon nitride inclusions in the field isolation
 region by exposing a field region of the semiconductor substrate to a hydrogen-free
20 oxidizing ambient at a pressure between about 5 atm and 30 atm.
9. The field isolation region of Claim 8, wherein the semiconductor substrate
 is maintained at a temperature greater than 900 °C while exposing the field region.
11. A process of forming electrically isolated integrated devices in a silicon
 substrate, comprising:
25 masking portions of the substrate to define unmasked field isolation
 regions;
 growing field oxide in the field isolation regions without forming silicon
 nitride inclusions in the field oxide by hydrogen-free oxidation alone at an oxidant
 partial pressure between about 5 atm and 30 atm and a temperature of greater than
30 about 900°C; and
 forming electrical devices between the field isolation regions.
12. The process of Claim 11, wherein growing the field oxide comprises
 exposing the field isolation regions to an oxidant consisting essentially of oxygen.

14. A process of forming an integrated circuit on a semiconductor substrate, comprising:

masking portions of the substrate with a mask comprising silicon nitride;

5 growing a field oxide in a single process step by hydrogen-free oxidation alone to a thickness sufficient for electrical isolation of devices within the substrate without forming silicon nitride inclusions therein;

removing the mask after growing the field oxide; and

forming a gate oxide of uniform thickness adjacent the field oxide on the semiconductor substrate without performing a prior sacrificial oxidation.

10 16. The process of Claim 15, wherein growing the field oxide further comprises maintaining the oxidant partial pressure at about 5-30 atm.

17. The process of Claim 15, wherein growing the field oxide further comprises maintaining the substrate at greater than about 900°C.

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